

**ELECTRONIC DEVICE WITH MULTI-BAND  
ANTENNA FOR SUPPORTING CARRIER  
AGGREGATION USING NON-SEGMENTED  
CONDUCTIVE BORDER MEMBER**

**CROSS-REFERENCE TO RELATED  
APPLICATION**

[0001] This application claims the benefit under 35 U.S.C. §119(a) of Korean Patent Application Nos. 10-2015-0108246 filed on Jul. 30, 2015 and 10-2015-0189250 filed on Dec. 30, 2015 in the Korean Intellectual Property Office, the entire disclosure of which is incorporated herein by reference for all purposes.

**BACKGROUND**

[0002] 1. Field

[0003] The following description relates to an electronic device including a multi-band antenna that supports carrier aggregation (CA) using a non-segmented conductive border member.

[0004] 2. Description of Related Art

[0005] Portable electronic devices, such as smartphones, being designed to include a metal exterior have become popular. The metal exterior has drawn much attention to improve external rigidity and to protect an interior of the portable electronic device.

[0006] For example, a conductive border member is used in the exterior design of the electronic device, and a conductor frame is embedded in the interior of the electronic device.

[0007] Research and development is being conducted to use the conductive border member of portable electronic devices using metal exterior as a portion of an antenna.

[0008] For example, in existing antenna using the conductive border member of the portable electronic device or in using conductive border member as a portion of the antenna, a gap (or segmentation) may be formed, from which a portion of the conductive border member exposed externally is removed. The gap allows the segmented conductive border member to be used as the antenna.

[0009] As such, segmenting the conductive border member may secure a length and performance of the antenna. However, segmenting of the conductive border member may spoil an appearance and have a low yield upon metal processing.

[0010] Further, to secure antenna performance, most of the electronic devices may use the segmented conductive border member having a total of four segmentations including two upper segmentations and two lower segmentations.

[0011] For example, the four segmentations use separate independent conductive border members at centers of the upper and lower portions thereof as the antenna. Also, in the four segmentations, a separate manufacturing process is needed to for the segmented portions upon manufacturing of a metal frame and, therefore, productivity may be reduced and a defect rate may be increased. As a result, in an electronic device with a non-segmented conductive border member, not the existing segmented structure, a need to secure antenna performance needs to be increased.

[0012] Meanwhile, as a part of an evolution trend of a long term evolution-advanced (LTE-advanced) communications system, carrier aggregation (CA) technology that is a core technology of 3rd Generation Partnership Project release-10

(3GPP Rel-10) has standardized technologies of combining more than two carriers to efficiently use a frequency and to improve a maximum transmission rate.

[0013] As an example of communications methods of supporting the foregoing LTE-advanced carrier aggregation (CA) may be communication methods, such as, for example, 1UL/2DLs inter-band CA, 1UL/3DLs inter-band CA, or TDD-FDD CA.

[0014] A downlink data transmission rate may be up to 150 Mbps (category 4UE) in the case of 2-layer transmission, in which the number of receiver antennas of the electronic device is two, and may be up to 300 Mbps (category 6UE) in the case of 4-layer transmission, in which the number of receiver antennas of the electronic device is four, or when the number of receiver antennas is two and 2DL CA is used. To this end, a technique of designing a receiver antenna has been highlighted as an important problem.

[0015] Further, due to the structure of the electronic device using the conductive border member, the number of receiver antennas may be increased and, therefore, an isolation problem between the antennas may occur. As a result, the isolation problem needs to be solved.

[0016] Considering the foregoing matters, to support frequencies for each communications company in each country, an electronic device using the conductive border member needs an improved and innovative antenna structure.

**SUMMARY**

[0017] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

[0018] In one general aspect there is provided an electronic device, including a first feed terminal connected to a circuit of a substrate embedded in the electronic device, a second feed terminal connected to the circuit and electrically insulated from the first feed terminal, a ground disposed on the substrate, a conductive border member continuously disposed along a periphery of the electronic device, a first antenna connected to the first feed terminal and the conductive border member, and forming a multiple resonance for covering a first multi-band having a plurality of bands, a second antenna connected to the second feed terminal and the conductive border member and forming a multiple resonance for covering a second multi-band, and a bypass conductor configured to bypass interference signals generated by the first antenna and the second antenna to the ground.

[0019] The first antenna may include a first antenna pattern disposed along an edge of a cover of the electronic device, the first antenna pattern having one end connected to the first feed terminal and the conductive border member and the other end open, and having a first electrical length, and a first bridge antenna pattern disposed on the cover and pattern having one end connected to the first antenna pattern and the other end connected to the conductive border member.

[0020] The first antenna may include a first outer conductor including a portion of the conductive border member from a first point connected to the first feed terminal and the first antenna pattern to a second point spaced at a second